Notes by-

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E-A

Environmental Engg.

Water Requirement

1981 - 1990:- International Drinking Water Supply & Sanitation Decade (IDWSSD)
IDWSSD was officially launched on Nov 10 1980 in UN General Assembly.

* Important points of water supply scheme:- (FPQRSSTT)

1) Financial Aspect
2) Population
3) Quality of water
4) Rate of consumption
5) Sanitary Survey of area
6) Sources of water supply.
7) Topography of area.
8) Trends of town development.

Syllabus (EE-I)

1) Quality of Water
2) Sources of water
3) Pumps
4) Sedimentat^n tank
5) Coagulation
6) Filteration
7) Disinfection
8) Water Softening
9) Conveyance of water
10) Distribut^n system
11) Miscelaneous treatment
12) Pipe appurtenances

* Drawings prepared for WS Project:-

1) Contour Plans:- Select Scale: 1:100
2) Detailed Drawings of various parts of scheme
3) Line diagram of sequence of operation
4) Site Plan: Scale 1:500
5) Topographical map: Scale 1:50

* Report of WS project includes:-

1) Need of WS Project
2) General consideration:- Population, topography etc.
3) Installation of various component parts.
4) Comsumption Requirement
5) Sources of supply: Reability, suitability etc.
6) Standard of Purification:- Quality of water, impurities, recommended mtds, design of various parts etc.
7) Pump & Pumping station:- Location, mtd. of operat^n, design etc.
8) Distribution System:-
9) Location, dimensions, capacity and design of reservoir & CHBET
10) Pressure
11) Fire Protection.
12) Cost analysis.
13) Economy of scheme with justification 14) Summary.

Sources of Water:-

a) Surface sources - lakes, streams, rivers & storage reservoirs, Dam
b) Sub-Surface sources - Infilteration galleries, wells, springs etc.

Points considered while selection of site for WTS Project:-

1) Smooth movement of water from one component to other.
2) As far as possible, pumping of water is avoided & flow of water is under gravity.
3) Possibility of future expansion.
4) Pleasant atm.
5) Cost.

Quantity of Water:

The quantity of water mainly depend on-

1) Rate of demand.
2) Population of area.

1) Rate of Demand:-

The demand of water is divided in to-

a) Domestic Purposes
b) Civic or public purposes.
c) Industrial purposes.
d) Business or trade purposes.
e) Loss or wastage.

a) Domestic Purposes:-

1) Drinking	2 Lit/day./capita
2) Cooking	5 Lit/day/capita
3) Bathing	30 Lit/day/capita
4) Washing	5 Lit/day/capita
5) Sanitary Purpose	50 Lit/day/capita
6) Gardening	
7) Animals & Vehicles.	

b) Civic or public purposes:-
1) Road Washing:- 5 lit/day/capita
2) Sanitation 3 lit/day/capita
3) Ornamental Purposes - fountains etc.
4) Fire demand:-
Buston's formula: $Q = 5663\sqrt{P}$ - England
Kuichlings formula: $Q = 3182\sqrt{P}$
Indian condition ⇒ 1 lit/day/capita.
P = Populat°.

c) Industrial Purposes:-
1) Factories.
2) Power stations.
3) Railways & airports.

d) Business & Trade purposes:-
1) Dairies
2) Hotels
3) Laundries.
4) Motor Garage.
5) School / Hospitals / Cinema Hall.

e) Loss & wastage:-
1) Careless use of water
2) Leakages in pipeline, valve, other fitting.

India's per capita per day consumpt° of water = 150 to 3

x Factors affecting Rate of demand:-
1) Climatic condition:- In summer & hot places comsumpt° is more In winter & cold places comsumpt° is le : but in extreme cold places people keeps water tap open to avoid freezing of pipes, so compamption may increases.
2) Cost of water:- Higher the cost, less is the rate of demand.

3) Distribution Pressure :- ↑ with increase in distribut° pre., water comsumpt° increases.

4) Habit of people :-

5) Standard of living.

6) Type & Number of industries.

7) Policy of metering.

8) Quality of water.

9) Sewerage system.

10) Size of city.

11) System of supply :- Continuous / Intermittent.

* Measurement mtds. of water :-

1) Displacement type :- A number of time a vessel of known of vol. is filled & emptied is measured. (small quantity.)

2) Velocity Type :- Turbine / Venturi type.

* Variation in Rate of demand :-

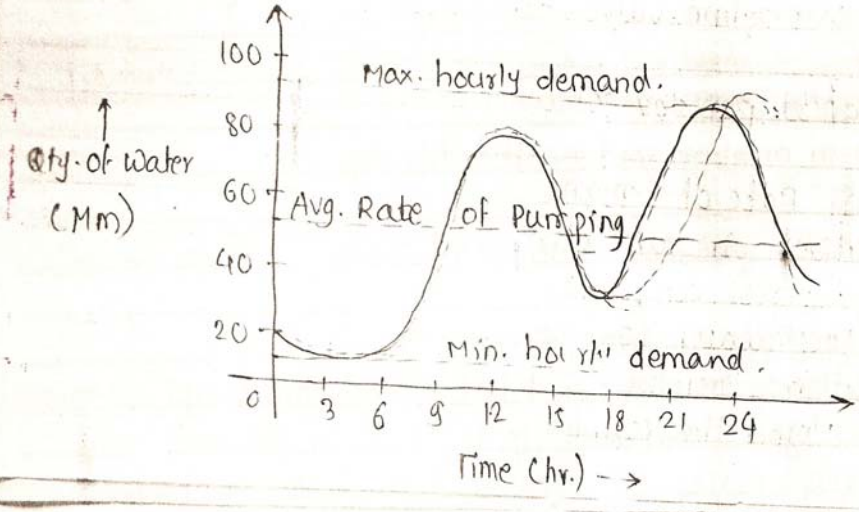
1) Seasonal max. demand

2) Monthly max. demand

3) Daily max. demand

4) Hourly max. demand.

Plot of quantity of water Vs time is plotted on a graph paper shows variation in qty. of water Vs. time due to various factors.



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* Estimation of Population:-

The component parts of WS projects are designed for a known period. This period should not too short to make plant obsolute or uneconomical & should not too long to throw unnecessary burden of financial on future generation. So design period is based on the future population.

* Mtds. of populat^n forecast / Projection:-

1) Arithmatic Increase mtd.
2) Geometric Increase mtd.
3) Incremental Increase mtd
4) Graphical mtd.

} Basic assumpt^n:- Rate of increase in population is constant.

5) Comparative mtd.
6) Zoning mtd.
7) Ratio & correlat^n mtd.
8) Growth-composition analysis mtd.
9) Logistic curve mtd.

1) Arithmatic increase mtd

$[P_n = P + n i]$

P_n = Population at n^{th} decade.
P = Present Population.
n = No. of decade
i = Avg. increase in population per decade.

2) Geometric Increase mtd:-

Assumpt^n:- Percentage increase in population from decade to decade is constant.

Suitable:- old cities which are not undergoing further development

a) Assumed percentage increase in populat^n can be calculated by-

a) Arithmetic Avg:-

$$r = \frac{r_1 + r_2 + r_3 + \ldots + r_n}{n}$$

r = arithmatic avg.
n = No. of decade.

b) Geometric Avg

$r = \sqrt[n]{r_1 * r_2 * r_3 \cdots * n}$

$\therefore \boxed{Pn = (P+1) \times r^n}$ $\boxed{Pn = P + r\,Pn}$

3) Incremental increase mtd:-

combines arithmatic ~~avg~~ increase mtd. & Geometric ~~avg~~ increase mtd.

Gives satisfactory Result.

$\boxed{Pn = P + ni + nk}$

P = Present Population

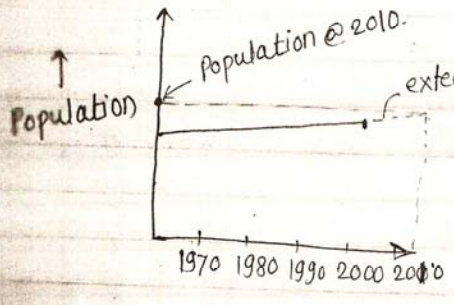
Pn = Populat^n after n decades.

n = No. of decades.

i = Avg. incremental increase = Incremental inc./n

K = Avg. geometrical increase = % increase /n

4) Graphical Mtd:- From the known sensus a curve is plotted by considering Population & the year. The curve is carefully increased for a e years under consideration.

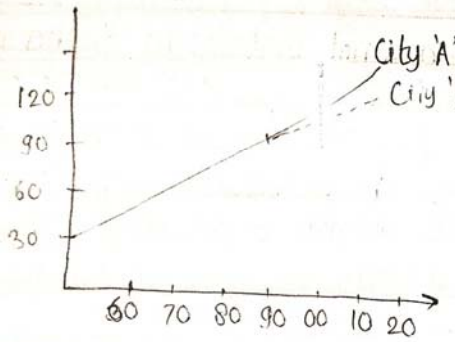


5) Comparative mtd:-

Assumption ① City under considerat^n will develop in same manner as other city had been developed in past.

② Growth of population is parallel to similar city.

In practice it is difficult to compare such cities.



6) Zoning Mtd:-
Master plan of each city is prepared & divided in several zones as residential zone, industrial zone, commercial zone etc.

7) Ratio & correlation Mtd:-
Growth of small area is related to population growth of whole area.

8) Growth Composition analysis mtd:-
Estimated populat^n = Present popul^n + National increase or decrease + Migration

* Factors affecting estimated population
1) Mtd. of populat^n forecast.
2) Natural orcident eg. big fire, epidemic, flood, earthquake, war.
3) Economic change.
4) Industrial development
5) Unforseen circunstances eg - discovery of oil, mine etc.
6) Political change.
7) Starting of new big project.

eg:-

1960	1970	1980	1990	2000	2010	2020
50000	47100	43500	41000	?	?	?

1) Arithmatic increase mtd:-

Year	Population	Arithmatic increase
1990	50000	2902
1980	47100	3600
1970	43500	2500
1960	41000	
		9000

$$i = \frac{9000}{3} = 3000$$

$\therefore P_1 = P + ni = 50000 + 1 \times 3000 = 53000$
$P_2 = P + ni = 5000 + 2 \times 3000 = 56000$
$P_3 = P + ni = 5000 + 3 \times 3000 = 59000$

2) Geometric increase mtd.

Year	Populat°	Percentage Arithmatic increase	Incremental Geometric increase
1960	50000	$\left(\frac{50000-47100}{47100}\right)\times 100 = 6.16$	47100 − 50000 = −2900
1980	47100		43500 − 47100 = −3600
1970	43500	8.23	41000 −
1990	41000	6.097	
		20.487	

Year
1960
1970
1980
1990

Arithemetic Inc. = $r = \frac{20.487}{3} = 6.829$ (%)

Geometric Increase = $r = \sqrt[3]{6.16 \; 8.23 \times 6.097}$

$= 6.76\%$

$= 0.0676$

∴ Population at 2000, $P_1 = P + rnP = (1+rn)P = (1+6.829) \times 50000$

$= 53414.5$

$P_1 = (0.0676 \times 1 + 1) \times 50,000 = 53380$

$P_2 = (1 + 0.0629^{\times 2}) \times 50000 = 56290$

$P_2 = (1 + 0.0676 \times 2) \times 50000 = 56760$

$P_3 = (1 + 0.0629 \times 3) \times 50000 = 59435$

$P_3 = (1 + 0.0676 \times 3) \times 50000 = 60140$

Incremental Increase mtd.

		Increas in pop.	Incremental increase
1970	41000	2500	
1960	43500	3600	1100
1990	47100	2900	−700
2000	50000		
		9000	Net = +400

$i = \frac{9000}{3} = 3000$ $\quad \therefore r = \frac{400}{2} = 200$

$P_n = P + ni + nr$

$P_1 = 50000 + 1 \times 3000 + 1 \times 200 = 53200$

$P_2 = 50000 + 2 \times 3000 + 2 \times 200 = 56400$

$P_3 = 50000 + 3 \times 3000 + 3 \times 200 = 59600$

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Year	Population	Increase in populat^n	Incremental increase	% age increase
1960	41000	43500 - 41000 = 2500	3600 - 2500 = 1100	43500 - 41000 / 41000 = 0.060
1970	43500	3600		47100 - 43500 / 43500 = 0.0828
1980	47100	2900	- 700	50000 - 47100 / 47100 = 0.0615
1990	50000			
	Total ⇒	9000	+ 400	0.2052
		$i = \frac{9000}{3}$	$K = \frac{400}{2}$	$r = \frac{0.2052}{3}$
		$i = 3000$	$K = 200$	$r = 0.0684$

1) Arithmatic Increase ⇒ $P_n = P + ni$
2) Geometric Increase ⇒ $P_n = P + n \cdot r \cdot P = P(1 + n \cdot r)$
3) Incremental increase ⇒ $P_n = P + ni + nk$